UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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REACTOR DECOMMISSIONING SPENT FUEL

POOL RISK MEETING

U.S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Conference Room 0-10B4
Rockville, Maryland

Friday, November 19, 1999

The above-entitled meeting commenced, pursuant to notice, at 1:32 p.m.

PARTICIPANTS:

WILLIAM HUFFMAN, NRR/DLPM/PDIV-3
BILL HENRIES, Maine Yankee
JOHN HANNON, Branch Chief, Plant Systems Branch
ALAN NELSON, NEI
LYNNETTE HENDRICKS, NEI
KEN CANAVAN, GPU Nuclear Corp.
BRIAN THOMAS, NRR/SPLB

PARTICIPANTS: [Continued]

EDWARD D. THROM, NRR/DSSA/SPSB
GLENN KELLY, NRR/DSSA/SPSB
LARRY KOPP, NRR/DSSA/SRXB
RICHARD DUDLEY, NRR/DLPM

GEORGE HUBBARD, NRR/DSSA/SPLB
MICHAEL T. MASNIK, NRR/DLPM/PDIV-3
SUZANNE BLACK, NRR/DLPM
ANTHONY MARKLEY, NRR/DRID/RGETS
MIKE CHEOK, NRR/DSSA
GARETH PARRY, NRR/DSSA
KIM GREEN, Scientech/NUSIS
TONY ULSES, NRR/DSSA
SIDNEY CRAWFORD, Consultant
JOSEPH STAUDENMEIER, NRR/SRXB
GOUTAM BAGCHI, NRR/DE
P.J. ATHERTON, PJA SVC1
AMY SHOLLENBERUS, Public Citizen
MARK RUBIN, NRR/SPSP
STUART RICHARDS, NRR/PD4
RICHARD BARRETT, NRR/SPSB
DIANE JACKSON, NRR/DSSA/SPLB
TANYA EATON, NRR/DSSA/SPLB

P R O C E E D I N G S

[1:32 a.m.]

MR. HUFFMAN: This is a meeting, a follow-up, like I said, to the November 3rd meeting that we had with Sam Collins and most of the people here. During that meeting we agreed to have a more detailed progress report from the staff to NEI and the public stakeholders. We have a detailed agenda which we will be following, and we have, you can see there is a relatively short period of time for this introduction and our review of the discussion objections. And then we are going to give 30 minutes to Mr. John Hannon and then another 30 minutes to Rich Barrett for the areas they will be covering.

If NEI wishes to make any comments or have any points they want to mention, they certainly are welcome to interject during the presentations. But if there is an additional follow-up, we have allotted 15 minutes for them, and we have also allotted 15 minutes for any other public comments, and then we will summarize and conclude, and take any actions at the end.

One other item I am going to enter for the record, and I will be happy to pass extra copies around, is Dave Lochbaum sent us a letter from the Union of Concerned Scientists, and he stated he wouldn't be here today, but he would like to have had this entered into the record as some of his opinions, mostly as a follow-up to the Commission meeting, and so I will make that a matter of the record. And if anyone wants one, I will be happy to circulate them.

With that, I guess we should start a brief introduction.

MS. BLACK: My name is Suzi Black, I am the Deputy Director, Division of Licensing Project Management in NRR.

MR. HUFFMAN: And I am Bill Huffman, I am a Decommissioning PM for SONGS and also responsible for the Decommissioning Regulatory Improvement Initiative.

MR. RICHARDS: Stu Richards, I am the NRR Projects PD responsible for decommissioning.

MR. BARRETT: I am Rich Barrett, I am Chief of the Probabilistic Safety Assessment Branch, and the members of the Working Group who do the risk analysis work for me.

MS. JACKSON: I am Diane Jackson, I am in the Plant Systems Branch at NRR, and I am the Lead Engineer for the Technical Working Group.

MR. HANNON: I am John Hannon, Branch Chief in the Plant Systems Branch.

MR. CANAVAN: Ken Canavan, GPU Nuclear.

MS. HENDRICKS: Lynnette Hendricks, Director of Plant Support, NEI.

MR. NELSON: Alan Nelson, Plant Support, NEI.

MR. HENRIES: Bill Henries, Engineering Manager at Maine Yankee.

MR. MARKLEY: Tony Markley, NRR, Generic Issues and Rulemaking.

MR. CHEOK: Mike Cheok, PRA Branch, NRR.

MR. PARRY: Gareth Parry, NRR.

MS. GREEN: Kim Green, Scientech.

MR. ULSES: Tony Ulses, Reactor Systems Branch.

MR. CRAWFORD: Sid Crawford, Consultant.

MR. STAUDENMEIER: Joe Staudenmeier, Reactor Systems Branch, NRR.

MR. BAGCHI: Goutam Bagchi, NRR/DE.

MR. KELLY: Glenn Kelly, PRA Branch, NRR.

MR. THROM: Ed Throm, PRA Branch, NRR.

MR. THOMAS: Brian Thomas, Plant Systems Branch, NRR.

MR. KOPP: Larry Kopp, Reactor Systems Branch, NRR.

MR. DUDLEY: Dick Dudley, Decommissioning Project Manager, NRR.

MR. HUBBARD: George Hubbard, Plant Systems Branch, NRR.

MR. MASNIK: Mike Masnik, Section Chief, NRR.

MR. RUBIN: Mark Rubin, PRA Branch, NRR.

MR. HUFFMAN: If you don't mind, you can briefly introduce yourselves and then we can --

MS. SHOLLENBERUS: Amy Shollenberus with Public Citizen.

MR. ATHERTON: Peter James Atherton, of Independent Public Symposium.

MR. HUFFMAN: Okay. With that I think we can get going again. We have got a couple of objectives here. One is the staff to update the industry and the public as to where we are and how we are progressing on the spent fuel pool risk assessment, and also provide an opportunity for public stakeholders and the industry to question and comment on this process, anything they may wish to say.

And with that I am going to turn it over to Mr. John Hannon of the Plant Systems Branch.

MR. HANNON: Okay. As Bill indicated, I am going to spend maybe a half hour or so going over where the staff is on three topics in the technical review. We are going to talk a little bit about the heavy load drop analysis, about where we are on the seismic risk evaluation, and then on our criticality assessment. And so, you know, if anybody has any questions, just stop me. If I can't get into that level of detail, we have staff in the room here that are familiar with the details and we can address your concerns.

So I am going to pass around -- I have a set of talking points on each one of these topics. We will deal with them each individually. First is the heavy load drop analysis. I am passing around a set of talking points I will use to go through that material with you.

First is the analysis assumptions and bases for the work that the staff has done. We employed the more recent data we have received from Navy heavy load drop events. One thing that we should be aware of when we talk about this subject matter is we have event data, but we don't really know how many total number of lifts have occurred, so there is an incompleteness in our database and that results in some difficulties when we try to talk about it. We can give estimates of range of heavy load drops, but we don't really have what you could call a true distribution.

So we have tried to improve on the analyses that we are doing for NUREG-0612. In this current evaluation we have looked human error rates associated with rigging failures, and that was a major contribution to some of the -- to a good percentage of the drops that have occurred, or the events that have occurred. And we have tried to evaluate the human error rates, and we feel that we have improved the state of the art from where we were in NUREG-0612.

We are also planning to, in our report in January, identify what I will call the mean estimate for these ranges. And the reason we want to do that is so that the numbers can be used in a way that is compatible with the application of risk numbers in Reg. Guide 1.174. So we do intend to have the central tendency, if you will, for these ranges to be identified as a mean for purposes of incorporating into our risk study.

Now, our current estimates of the frequency of heavy lift problems that could lead to damage. Spent fuel pools and loss of inventory evaluated for 100 lifts for a single failure proof system per year. The ranges you see on the slide there was 2.8 E to the minus 8 per reactor year on the low end of the -- not distribution, the range, and on the high end of the range it is 2.1 times E to the minus 6 per reactor year. And you will notice that the numbers for a non-single failure proof system, which are based on NUREG-0612, are roughly an order of magnitude higher. So you do gain something when you have a single failure proof system.

Now, we did take the NEI data that you all provided us, the incident rate data that you provided us, and used it to requantify the fault tree and we came up with some revised numbers, although there was a minimal change in the resulting frequency estimates. And you can see that the comparison between the numbers for single failure proof system are pretty comparable.

In the final analysis here, where we are coming out on this particular aspect of our Technical Working Group is that the NEI commitments to Phase II of NUREG-0612, plus the additional commitments you made regarding the administrative restrictions you would place on heavy load movements and other procedures you would have to control operations near the spent fuel pool. The combination of those commitments will help assure the low probability of an event, and provide a diverse means of protection which will indicate that there is reasonable assurance that the risk from heavy load type events is acceptable.

Now, one thing I point out here with this particular part of the technical work, we have not completed the independent technical quality review of it yet, so what I have said so far is subject to change, pending the results of that independent review.

That concludes what I intended to say on heavy loads. Are there any questions before we move to the next subject? Comments.

MR. HENRIES: Just one, you mentioned in January you are going to be coming up with a way of coming up with the mean between the 10 to the minus 6, 10 to the minus 8. Any idea when in January, or any indication of where that number is going to come out at this point, or is it just wait and see?

MR. HANNON: The best information I have right now is that it will be published with the report in January. The numbers have been -- we have started looking at these numbers. We haven't really finalized what we are going to be saying about the mean estimate yet.

MR. NELSON: On the hundred lifts, is that -- how did you come to the hundred?

MR. HENRIES: It was our estimate that a robust loading plan, you are lucky to get one cask a week, so you have got once in, once out.

MR. NELSON: Because I thought that we had -- it would kind of be tough to meet one cask per week. I thought we were talking more -- cut them down from 200 to 100, so that was our recommendation, which was the same as NUREG-1353's assumption, essentially, 104 a year.

MR. BARRETT: This is Rich Barrett with the NRC staff. I think that if we do the analysis for 100 lifts a year and the licensee in fact plans to do 25 or 50, that is a simple adjustment in the numbers. And so 100 lifts can be an enveloping analysis or a benchmark analysis that someone can redo on a plant-specific basis if they plan to only do quite a bit fewer.

It seemed to me that there was some indication at the Portland meeting that for most plants, we are not talking about hundreds and hundreds of casks, we are talking about a total of maybe a hundred casks or maybe in that order of magnitude.

MR. HENRIES: I am Bill Henries from Maine. The plants I am familiar with, Yankee Rowe has 19, Maine Yankee has the most. We are going to have 60. So, you know, we are talking about a one time campaign that will take us slightly over a year. In operating plants they do one a month. So, you know, once again, if you stick with the hundred, and you cut it down to 10, it is very easy to quantify.

MR. BARRETT: Right.

MR. HANNON: Okay. According to the agenda we published for this meeting, we will talk about seismic risk next. Again, I have a set of talking points that will be passed around that you can follow along with what we are saying on the seismic analysis.

Okay. In our June, the Draft Technical Study that we published back in June, we looked at the seismic issue and determined that most plants could be likely to be able to be capable of withstanding a 3 times SSE type of an event, and that was considered to be roughly on the order of a .4 to a .5 g ground acceleration earthquake. And the likelihood, the frequency of those, an earthquake at that level to occur is estimated to be roughly 2 times E to the minus 5th per year. And then you combine that with the HCLF number to come up with what the likelihood of that kind of an earthquake causing a pool integrity problem, and it is roughly 10 to the minus -- 5 times 10 to the minus 2, to get an estimate for damage from an earthquake to be 1 times 10 to the minus 6 per reactor year.

And then we looked at the likelihood of other failures that could affect ability to cool the pool and concluded that the total seismic contribution for Central Eastern United States sites was on the order of 2 E to the minus 6 per year, and all that information was documented in the Draft Technical Study we published in June.

Now, subsequently, we have, of course, had the public meeting with NEI and we reached an agreement to try to work towards a checklist. NEI provided that checklist to us in August. In included seven items and we have had the technical quality review completed on that, and our result was that it was considered to be an excellent start, and that the concept of being able to come up with a checklist is valid.

It can be developed using the EPRI and Lawrence Livermore

National Lab hazard estimates, but the idea of being able to envelope the risk down to 1 times to the minus 6 was considered to be very difficult using a checklist, but the conclusion was that you could envelope the risk down to 3 times 10 to the minus 6, slightly higher. That equates to a .5 peak ground acceleration, which is pretty comparable to what we had before in the draft, or a 1.2 peak spectrum acceleration, which is a more refined way of looking at the actual impacts on the spent fuel pool, taking into account the lower frequency range of where the damage would be expected to occur.

By using this approach, our ITQR concluded that we could avoid detailed fragility reviews at most of the Central Eastern United States sites. He did have some additional considerations for us to look at. One was to be able to try to strengthen this checklist in two areas he felt would be needed to be looked at to provide the kind of assurance we are seeking. One was out-of-plane flexural and shear failure modes, that was not addressed in the earlier version. And then a second area was to try to beef up the Level 2 screening requirements for the in-plane flexure an shear. It is particularly important for older plants that may not have been designed to the later codes.

So, with that strengthening of the checklist, the concept appears to be valid that we would avoid having to do detailed fragility for all but about six of the Central Eastern United States sites. Those are the ones that have above ground pools without -- with walls that are not backfilled with soil, and there is a likelihood that those plants would need to do more to be able to demonstrate they have the adequate capability. And, of course, we have -- we will be addressing the sites west of the Rocky Mountains in the report that we come out with in January.

I left a place over here for discussion of what next steps you all might want to suggest we take, given that as a background, or maybe it is too early to talk about that now. I just had a placeholder there in case somebody had some suggestions or comments.

MR. HENRIES: I have two. It is the total seismic contribution, essentially a doubling of the seismic challenge, is that basic the add-on of the failure, associated loss of cooling, loss of power?

MR. HANNON: Correct. In addition to things that can happen beyond just the impact on the pool itself.

MR. HENRIES: I concur that they can happen. It was our hope that those would be lumped not as a seismic event, but would be put back into where the human response, you know, the failure probabilities to respond, because we don't have a catastrophic failure now, we basically have a small leak or a loss of power, loss of cooling scenario where they, once again, will have the "luxury" of time and time to respond.

So if we put those in a different bin, if you will, you could handle them as part of the human failure side, human risk side, does that have a significant effect on the conclusions here?

MR. BARRETT: This is Rich Barrett again. I think you are probably right, and I will ask Glenn Kelly in a second to tell me whether or not I am correct on this. But I believe that those scenarios are for earthquakes of lower magnitude, but higher frequency, and, therefore, they would not necessarily be disruptive of response. And so, technically, it seems like you would be correct, that we could deal with those more in line with -- as just another way of getting to a loss of heat removal or a loss of inventory event -- not a loss of heat removal probably, and that those probabilities would change based on -- no?

MR. KELLY: No.

MR. BARRETT: I am getting a no here from Mike Cheok.

MR. KELLY: The answer is no, that is not --

MR. BARRETT: That is not true.

MR. KELLY: Part of what you said is correct and part of it is not correct.

MR. BARRETT: Okay.

MR. KELLY: The answer is yes, that it is based on lower magnitude earthquakes. Well, the factor of 2 -- well, I will let Mike talk about it.

MR. CHEOK: This is for 3 times SSE earthquake, all right. We assume that 5 percent of the time you do fail the pool, and given that 95 percent of the time for a 3 times SSE earthquake, you assume that you have at least a loss of off-site power and a loss of equipment due to the fact that it will not be similar the other transients because these things are non-recoverable, as opposed to a regular slow-moving transient, most of the things are recoverable, and you can be -- repair is possible.

In a 3 times SSE earthquake, we assume that off-site power may not be recoverable. Your pumps might be failed because they are not seismically qualified and other things. So this accounts for the fact that the recovery is --

MR. KELLY: And it also includes the fact that -- and it does include all lower level earthquakes that will have an impact there, because we are talking about 3 times SSE, so even at two times SSE, you are talking about considerable impact on the infrastructure in that.

MR. HENRIES: And I tend to agree with everything that is said, but, indeed, the response to fixing things that are damaged in an earthquake, you know, the onsite equipment may indeed be damaged, but the local fire departments or the fire departments from a hundred miles away wouldn't be. You know, we are still talking about an event where you would have let's say seven days. So within seven days of an earthquake, which is not, you know, a typhoon that is going to be there forever, the ability for the onsite people to actually make the phone calls to bring in the off-site response to provide makeup water is the only function we are talking about. You know, a fire -- one fire truck within a hundred miles could be there easily within five days.

MR. CHEOK: I agree with you, and that has been taken into account. If you look at your 3 times SSE earthquake, it is 2 times 10 to the minus 5. It now becomes a 1 times 10 to the minus 6 from -- I mean they do take into account the fact that you do recover from off-site sources. We did not credit recovery from onsite sources. That is why you get the difference between 2 E minus 5 and 1 E minus 6 in that case.

MR. KELLY: The factor of 20 difference comes from the off-site recovery thing. Given that you have an earthquake 3 times the SSE, you know, 95 percent of the time you are going to be able to recover satisfactorily.

MR. HENRIES: But the total failure is doubled for the challenge to the pool. So the contributions of these earthquakes taking out cooling and power is equal in magnitude or in risk to the total collapse of the pool. We have gone from 1 E to the minus 6 to 2 E to the minus 6.

Now, my argument is those failures should be treated as loss of cooling, loss of power, with different risk, okay, it is harder to make up than it would be if we had all the other things, but could be treated in a non-seismic realm.

MR. KELLY: And, again, I think the key here is we are not -- we are really, honestly, not focusing on getting exactly where that number is going to be. What we have been trying to use the numbers for is to point out where are areas that we have some, potentially have some worries that we need to take care of. And so we have identified, in looking at the human error rates, or looking at that, and our additional work that we are doing on human error rates may come back and modify some of these numbers here also, because this does not reflect our changed human error rates.

And, again, I think the key that we are going to even -- even when we are saying that, you know, we are forgetting about the additional possibility of -- or even if you are 100 percent capable of always being able to provide any water, there is no chance of not being able to do that. We still have a fairly high generic estimate for what the risk is going to be, and we feel that, based on what we have seen here, and what we looked at with these additional considerations, that we believe that we are able at that point to provide good protection to the public as far as this is -- I don't see that we are seeing anything here that looks like it is unreasonable, and that we feel the use of the checklist, including the commitments that we have gotten from NEI provides us with a good basis for saying that there is -- I have to speak for myself here, because I haven't created all this, but for me, it seems like we have adequate assurance at this point that there is good protection there for the seismic events, given that you go through this checklist and that you have those commitments that NEI has made.

Now, that is also subject to these additional considerations.

MR. BARRETT: I'm going to be talking in awhile about our revised view of human reliability analysis and human error probabilities.

And I think I heard Glenn say that those changes would affect in some way, our preliminary estimate of this scenario.

MR. KELLY: That's so.

MR. BARRETT: I'll tell you that my presentation doesn't reflect that, and that's just an omission that I should have recognized.

But, you know, what we're striving for here is to have -- is to characterize these scenarios as accurately as we can.

And so let me say that while you're not going to hear those numbers today, or those results today, you have -- it's a valid question you've asked, and we should address it.

I think we would all agree on that, that we can address it and it's something that we should try to characterize, that particular scenario, as accurately as we can.

MR. BAGCHI: Can I say something? Just looking at the numbers, it's focusing on purely a probabilistic approach. This is a risk-informed approach.

If we agree that with the use of the checklist, and recognition of the fact that even at three times SSA, there is no catastrophic failure of a whole structure, then we're assured of being able to supply additional coolant and try to avoid the worst scenario that could follow without any kind of coolant because the pool is capable of retaining the water.

If we agree that we can not base it purely on a probabilistic basis, on a pure number, you can see that our consultant has come up with a number which is three times 10 to the power minus 6, which would leave out eight plants where additional work may need to be done.

I think we should be focusing on a risk-informed approach where use of a checklist and some inspection of the pool to ensure that there is no preexisting weakness in the pool structure or some vulnerability, and then we should deal with seismic, not on a probabilistic basis, but on a risk-informed basis.

We should not be focusing on a number, per se.

MR. HANNON: Are there any comments or question on the seismic area?

(No response.)

MR. HANNON: Okay, then the next topic is the criticality analysis.

MR. NELSON: Before we go on, I guess Bill and I were talking about going back to your next steps. I mean, you're going to go back and take a look at what Bill Henries's question is, and then you will get back to us?

I was just looking at -- what will expect from us as the next step as far as the checklist is concerned?

MR. HENRIES: I was hoping that I would get comments back or suggestions on modifying it, which would be coming from Goutam and the Staff.

MR. BAGCHI: You have gotten one comment, which is that you need to take care of the auto share and things like that, but there are other things.

If there are outlier plants, what's the plan of action? Should we do some preliminary evaluations in seismic evaluations so that we can proceed with the rulemaking without keeping plant aside.

MR. HENRIES: Yes, I would like to see what your recommendations are. I know your consultant and I respect your consultant

MR. KELLY: This is Glenn Kelly with the Staff. I'd like to get a clarification from Goutam here.

It's my expectation that the three times 10 to the minus three of Bob Kennedy was strictly seismic and did not take into account, additional failures where the pool was not significantly -- part of our number, our number, when we came up with two times 10 to the minus 6, 50 percent of that was seismic catastrophic failure of the pool, and the other 50 percent came from pool is intact, but we lost cooling and then we lost the road infrastructure and other things such that it would be harder to get equipment out to the plant.

Here, my understanding is, or my expectation is that the three times 10 to the minus six was strictly based on potential for catastrophic failure of the pool.

MR. BAGCHI: That is so, it's loss of structural integrity, and it was done using complete convolution as opposed to our simplified assumption of big lift times the initiating, and that's how we came up with the higher number.

We also need to take into account, the West Coast sites in order to come up with some generic criteria. I have some ideas about that, but I think that would come out in the January timeframe.

If there is an agreement later on to make the seismic part of it public before that, we will have to see what we can do.

MR. HANNON: Would it be reasonable for us to provide a comment or a set of comments on their checklist to let them address that before we get to the final report; is that feasible?

I mean, you've mentioned a couple of things where they need to beef it up. Could we provide them with a specific list of what we consider?

MR. BAGCHI: My report is ready now. So, if that goes out, we can look at that and decide.

MR. HENRIES: Maybe you would call it a draft or something like that.

MR. BAGCHI: But it could come out.

MS. JACKSON: Perhaps we can at least have a meeting on it to discuss just the seismic area.

MR. BAGCHI: That's a possibility.

MR. HANNON: But the reality is that if we don't get NEI a submittal that has a revised checklist that accommodates the issues, that's going to be an open item in our report.

MR. HENRIES: And my plan is to turn it around, once I get some kind of hard feedback, other than the verbal.

MR. HANNON: Okay, then, why don't we plan to have a separate meeting just on that subject, and see if we can make some progress towards coming up with a revised checklist.

MR. BAGCHI: But do recognize that there's a list of comments, and for lack of a better word, I would say they're outliers.

MR. HENRIES: Right.

MS. HENDRICKS: And is it the intent that we would get that report prior to the meeting and have some time to review Goutam's report?

MR. BAGCHI: That would be my intention, because we need to see -- we have not identified those six sites, have not identified those numbers, so it needs to go there to Duke Engineering to provide the seismic hazard information.

We need to identify those, and a plan of action has to be developed.

MS. HENDRICKS: Just for planning purposes, is there anyway to get a tentative timeframe for that? You sort of know your own needs for when you need to have it finalized, and can we work back from that?

MR. BAGCHI: We need to involve Bob Kennedy as well, so it's going to take some coordination.

MR. ATHERTON: Can I ask a question? Now, this is Peter James Atherton. To what extent is -- since you haven't covered this that I'm aware of, to what extent has your consultant or yourself taken into account, the possibility of degradation of the spent fuel pool in determining the seismic capabilities? That's one.

Two, are you taking into account, individual differences between spent fuel pools? I'm not sure there are any two spent fuel pools that are identical.

MR. BAGCHI: I think the last one is absolutely, and so does NEI, I would believe. The first comment about auto sheer takes that into account, from one plant to another.

In the case of the plant, Maine Yankee, there is no auto shear concern, however, in another plant there would be. So, the answer to the last one is absolutely.

And so to the first point, I think you raised the question not only about the concrete structure itself, but also the liner.

In another meeting you had said that some pools have fiberglass liners. Based on some preliminary review and a quick check, our understanding is that there are only two pools that don't have any liner. All the other pools have stainless steel liners.

The two that don't have any liner are Indian Point I and Dresden 1. These have been decommissioned for a very long time, and they have not reported any unusual degradation problems that I know of.

Now, let's take the concrete. Concrete aging effect is to increase its compressive strength.

So, at the time of decommissioning, the concrete would asymptotically reach an increase in strength of about 20-22 percent. And I would put the degradation into two categories:

One is a short-term degradation, and the other is a long-term degradation. In the short term, during the earthquake, let's say, or following the earthquake within the next four or five days, if there is a crack pattern through which water seeps out, that degradation has no impact on the strength of the walls of the structure to retain its structural function.

Or, in other words, it should continue to provide the function even if there is a crack and there is water seeping through it. That's the short-term effect.

The long-term effect is that concrete has cracked substantially, water has seeped through, reinforcing bars have corroded, and they have reduced cross-sectional area to resist the forces.

If that were the case, then that kind of degradation would reduce its structural capacity. However, we have maintenance rules, and the seismic checklist would require examination that nothing -- and assurance that preexisting degradation is not there.

So, we can assume that at the time of the decommissioning, a pool goes in with full structural strength, and continues to do so because it's going to maintain all the requirements of maintenance and corrective action will be there.

So, that takes care of the concrete degradation. Do you have any question on that?

MR. ATHERTON: The degradation of concrete, is that -- are you considering factors such as temperature, water leakage, radiation, and perhaps other factors?

Exactly what factors are you taking into account?

MR. BAGCHI: I talked about long-term and short-term degradation. In the short-term, temperature is to produce some additional pressure on the concrete. The concrete bends; it does not create overall pressure.

It's a geometry-related constraint that is put on the structure by the temperature, and if you look at reinforced concrete, as long as the temperature stays around the boiling point of water and does not last for a long, long time, then there is no effect on the concrete structure.

If there is a temperature-related pressure in the concrete structure, there will be minor cracks and they will accommodate that change in geometry, and, therefore, no structural effect.

MR. HANNON: Goutam, is it fair to state that you're going to treat this subject matter in our report?

MR. BAGCHI: I have written something about that. And with respect to the liner, if there is some crack in the liner welds, minor amount of water will escape there, and that has, in my mind, no effect.

So far we have not seen any kind of degradation. There have been some minor leakages, and we have determined that the kind of seepage that goes through has not substantially degraded the structure.

MR. ATHERTON: What about the effects of exposure disks, over the long term, to radiation? How would that affect it?

MR. BAGCHI: Gamma radiation is only cause heating and the other radiation effect, the neutron concentration, a centimeter or something like that, is going to cause -- is going to be the determining factor for degradation.

There is no known degradation like that in concrete. We use concrete in shield wall right outside the reactor vessel.

MR. ATHERTON: What about the stainless steel liner for those plants which have it?

MR. BAGCHI: No problem.

MR. ATHERTON: The stainless steel is not adversely affected?

MR. BAGCHI: Not unless it exceeds a certain number. That number is in the reactor vessel, but in the spent fuel pool, it doesn't even approach that number.

MR. HANNON: Why don't we -- if we can't move on, if we have a plan of action here for the seismic analysis, we're going to have a phone call with you after we get our act together in terms of when we can have such a meeting and get the report to you. We'll get back to you by telephone.

On the criticality analysis, I believe we passed around the sheet for that. Several of the stakeholders from the public have raised this concern. I think Mr. Atherton was one of the ones who had raised this concern about criticality.

We did treat the subject in a June draft report. We identified several possible mechanisms that could produce a critical assembly or set of fuel in the spent fuel pool.

We looked at it at that point, and decided that those various mechanisms would be extremely unlikely or incredible to have occur.

Subsequently, we got a couple of additional mechanisms proposed to us by the independent technical review we had. One was a zirc-fire-induced fuel pellet reconstitution, and another initiators for rack deformation included seismic, heavy load drop and a fire melting of the boiler plates.

So we have all of these various mechanisms to evaluate, and our plan is to continue to assess these various mechanisms for their potential to cause a critical mass, and to evaluate any consequences that might come from that, and to assess the likelihood of these mechanisms actually occurring in the spent fuel pool.

We will treat this subject in the report that we produce in January.

MR. ATHERTON: I have a question.

MR. RICHARDS: Peter, I know you didn't hear the opening remarks, but in accordance with the agenda, the public comments are towards the end of the meeting. Could we ask for you to wait until that period of time to enter into a dialogue with the Staff?

MR. HANNON: That concludes the subjects that I wanted to cover. Thank you.

MR. BARRETT: Okay. I would like to address two topics, the last two topics in the technical part of the session here, namely, where we are with regard to human reliability analysis and how that affects the risk; and then I would like to talk about how we are viewing the whole subject of risk-informed decisionmaking.

So, let me start by addressing the human reliability analysis, where we stand on that. We have some viewgraphs that are being passed around.

I think that really most of the story is addressed on the first slide, at least qualitatively speaking.

If I could recap how we got to where we are today: In June, we did an analysis which identified human errors related to the identification of abnormal conditions, the restoration of failed functions, and the initiation of mitigative actions, using onsite and offsite resources.

The human error probabilities for those events were based on relatively generic types of values. And as you know and as we have discussed on many occasions, we did not give very much credit for the fact that many of these accidents have a very long duration in days.

This approach identified the important operator activities, the important human actions.

Following the workshop that we held in July, we, the NRC Staff, produced a revised analysis or approach which highlighted design and operational features that could result in high operator reliability in responding to upset conditions.

We sent that approach out for comment and for review by our two HRA experts, internal experts, NRC consultant experts. It was reviewed and endorsed by the two HRA experts, and has been revised to account for their comments.

A qualitative result of that analysis, as you saw in August and it stands today, is that we concluded that implementation of any NEI commitments would significantly reduce the risk contribution of loss of decay heat removal and loss of inventory events.

And those are the two classes of events which are most dominated by human reliability analysis.

Now, in addition to this qualitative review, we are also sponsoring a requantification of our model with one of our contractors.

I'll get to that in a moment, but before I do, on Slide No. 2 -- and you will notice that I have two slides numbered 1, so I hope that doesn't confuse anybody -- just to go into a little more detail about what were the attributes that we said in the August approach that were important here?

Okay, basically we based that analysis on conditions needed to accomplish three functions. And the three functions are: The detection and recognition of deterioration of the fuel pool cooling function;

Interpretation of the indications and formulation of a response strategy, and then execution of the strategy.

The revised approach acknowledges the conditions that are unique to decommissioning fuel pools as opposed to a reactor situation; slow-developing scenarios, in principle; simple systems and simple mitigating actions; and, of course, a little competition for operator attention.

What we looked at in the August review were features that were along the lines of what we talked about in the workshop, and along the lines that have been committed to in a recent letter from NEI.

There are alarms and indications; walkdowns and surveillances; response procedures; contingency plans, including actions to bring to bear, offsite resources; and, of course, equipment availability.

Now, as I mentioned, we are sponsoring an effort to requantify the HRA model. And that is based on the new staff approach and a somewhat revised PRA model.

And that is being used to requantify the results and also to demonstrate the value of adopting the NEI commitments.

Timing -- the timing of this review is that we actually got the preliminary numerical results either yesterday or the day before yesterday, so we don't feel comfortable putting them on the public record because we haven't had a chance to review them, and to conclude that we accept them as they are.

But the preliminary results, as they stand, support the qualitative conclusions that I mentioned earlier, namely that -- and I'll go back to the second Slide 1, last bullet -- that implementation of the NEI commitments significantly reduced the risk contribution of loss of decay heat removal and loss of inventory events.

So, we think that where we are is that we've come a long way since June. We've taken into account, the commitment that were made verbally at the workshop, the more detailed statement of the commitments that we got in the letter from NEI the other day, and that it has changed our qualitative views of these loss of heat removal, loss of inventory events, and it is significantly affecting the quantification of risk.

And we'll continue to evaluate those quantitative results, and make whatever adjustments are necessary.

Do you have any questions or comments?

MR. NELSON: I guess the next time we'll see those numbers would be?

MR. BARRETT: I would say that the next time you see -- our current plan would be that the next time you see them would be in the draft report in January.

Now, let me say that based on a comment earlier, I think we have an action item to take in to see what effect this new perspective would have on those seismic sequences that relate to loss of the heat removal function as opposed to catastrophic failure of the pool. We'll take that as an action.

MR. HENRIES: If Mike Meisner was here, I'm sure he would say he's appreciative that all of these things happened.

What we've gotten out of this over the past few months is, the insights that your first report brought up.

The importance of the procedure, I think we focused on for quite awhile, but besides our temperature and level and radiation alarms, we came up with the ideas that since we're a PLC-based alarm station, we put in a series of alarms that will capture small leaks from 30 gpm to a thousand gallons a day, so now we have another level of alarm prior to the low level point.

Similarly, we went out and bought a gas-fired pump, a small one, so that if the diesel-fired pump were to go, we've got another source. So all the things that your risk-based information was showing really does; it shows you what to focus on, and it's small money.

So you can add layers and you do get insights.

MR. BAGCHI: But NEI is not making a commitment for the entire industry to do all of those things.

MR. HENRIES: No, they're not.

MR. BAGCHI: But each site.

MR. HENRIES: Each site does their own, but I think that those who follow the issue, you know, can do as they see fit.

MR. RICHARDS: A gas-fired pump, just out of curiosity, what did that cost, and what kind of capacity does it have?

MR. HENRIES: I think it was about a 30 gpm pump and I think it was a few hundred dollars. I'd have to get the number. I may have been as much as a thousand, but given the industry, that's not one of the major concerns.

MR. BARRETT: It is important to recognize that the study we are doing here is at a conceptual level. We are talking about procedures and we are talking about offsite resources. These are very abstract, rather abstract terms. When it comes down to the next step, when we talk about what does this mean in the regulatory arena, you know, I think clearly we have to put some flesh on the bones, along the lines of what you are talking about.

Okay. Let me move on to a topic that I think deserves a lot of thought and we really only talked about it in some very vague terms at previous public meetings and that has to do with the whole question of how do we go about making decisions?

In the context of Regulatory Guide 1.174. we were directed by the Commission to make this a risk-informed decision process. We have been out doing a lot of risk analysis but it is only in recent weeks that we have begun to ask the question, well what are our criteria, how good is good enough, how will we know when we're done, and as you well know the Commission asked us some questions about that last week.

So let me share with you what I think is the thinking that we are doing. We go back to Regulatory Guide 1.174 for our guidance because if we don't go back to existing documents, then we are going to be stuck with a situation where we have to start from scratch and come up with criteria and get everyone's involvement and of course we'll have to have everyone's involvement as it is, but if we can tie it to decisions that have been made before, criteria that have been accepted in other arenas before, then I think we have a much simpler task.

So back to Reg Guide 1.174, which has not only been accepted for use in the regulatory process but has been demonstrated to be equivalent in many ways to other decisions that have been made, such as the definition of the safety goal policy for instance. In Regulatory Guide 1.174 I would say that we have two levels of guidance. At a more conceptual level we have some safety principles that were defined and I want to talk a lot today about the safety principles, but then at a numerical level we went down a level deeper and we put down some numerical criteria which would apply to licensing situations and changes to the licensing basis, and I would say that from our perspective the safety principles as they are stated in 1.174 are directly applicable to the decommissioning decisions.

The numerical criteria require a little more creativity to understand how they apply here, but anyway the five safety principles that are stated are that, first of all, you must meet the regulations unless you are asking for an exemption.

Secondly, you must take into account defense-in-depth and you must take into account the safety margins that are applicable -- that is the third one.

Fourth, increases in risk should be small due to risk-informed changes.

Finally, whatever decisions you make based on the risk-informed decision-making process we should have a mechanism for monitoring the performance in those areas that were crucial to making that risk decision. Those are kind of the five criteria or the five principles.

I want to discuss four of them because the one about meeting the regulations -- we will meet the regulations except insofar as we are given exemptions, which of course is also meeting the regulations -- 50.12.

First of all, let me talk about the numerical risk goals in Reg Guide 1.174 and the safety principle that the increases in risk should be small. Reg Guide 1.174 has goals related to core damage frequency and LERF, Large Early Release Fraction or frequency.

We recognized early-on that a spent fuel pool fire, zirconium fire, doesn't really fit either one of those two categories.

The consequences of such a fire would certainly be greater than a core damage accident, given that a core damage accident would happen inside of containment, but when you compare it to a large early release it is not as large and not as early, so we were not quite sure what to do about that.

At a recent meeting of the ACRS they suggested that it was close enough to define this as a LERF. In fact, their suggestion was that we should define the uncovery of the top of the fuel as being our criterion for declaring something a LERF. That's fine. That's useful guidance. We recognize that to define the uncovery of the top of the fuel as being a LERF is conservative to some extent, insofar as you still have a long way to go to uncover the fuel, but we recognize, as we did in our June report, that once you have gotten to the top of the fuel recovery actions are difficult because of the radiation levels.

We also recognized that it is somewhat conservative to call this a LERF because it is not necessarily as large as a LERF and it is not as early as a LERF but the ACRS has suggested using this criterion and I think it is close enough for us to start with.

In Reg Guide 1.174, we say that the base level of LERF, if you can show it is below 10 to the minus 5, that you can contemplate changes based on a risk-informed approach.

All of the analysis that we have done, that we are doing now, tends to point to the conclusions that this frequency is well below 10 to the minus 5. In fact, even our June report was in the vicinity of 10 to the minus 5, so if we use the LERF criterion, we would conclude that the base level of risk is such that we could contemplate changes to the design basis, exemptions or rulemaking, that would allow relaxation of the current rules.

If you do have a relaxation or an exemption the Criterion 1.174 says that the change in LERF should be kept below 10 to the minus

6. That is difficult because not all of these changes have any effect on LERF at all. For instance, the changes and exemption to the Emergency Preparedness requirements would potentially have an impact on the consequences associated with the LERF but they would have no consequence or no change on the impact on the frequency, the Large Early Release Frequency, LERF.

So in order to analyze the risk-significance of such a change we are going to have to understand the risk equivalent, we are going to have to come up with a risk equivalent criterion, something that is equivalent in risk, in delta risk, to a 10 to the minus 6 change in LERF. We haven't done that yet but we are in the process of looking at that and we think it can be done and we think that the analysis that we have we can reasonably be expected to give acceptable results, but we don't have those results yet.

Instead of changing the frequency of a large early release, what we are going to be doing is changing the consequence and the question is going to have to be is this changing consequence, given the base frequency, equivalent to the acceptable changes in frequency in Reg Guide 1.174, given our perception of the consequences -- and if you understood that -- so that is where we stand with regard to that safety principle.

The second safety principle let me say is the question of margins of safety. I think we have said many times here that the margins of safety are high when you are talking about spent fuel. If you are talking about fuel that is in a quiescent state, you are not operating at high pressures and temperatures and flows, and of course you have a lot of thermal inertia, the decay of so much of the fission products means that you have a lot of time for fuel damage to occur compared to a reactor accident, so there is a lot of margin there that you don't have in a reactor accident and we need to take that into account in this decision-making.

There is also margin insofar as the consequences cannot be as high because, and this is particularly important because you have had enough time for the iodines to decay away, you wouldn't have that in the reactor accident, so these are important features of margins. I would add what I said earlier, that in this case you have operators who can really focus on this single problem as opposed to focusing on so many other things in an operating reactor condition.

Defense-in-depth is somewhat complicated. The ACRS suggested that we take a rationalist approach to defense-in-depth. What I rationalist approach says is that you don't just put defense-in-depth in for the sake of defense-in-depth. That is what they call the structuralist approach. You put defense-in-depth in because it makes us feel good.

In a rationalist approach, you look at the uncertainties associated with your analysis and say what defense-in-depth do I have, do I need because of the uncertainties in my analysis. For instance, we do a seismic analysis and we conclude that the risk is something times 10 to the minus 6 but we have uncertainties in the seismic hazard function. How do we deal with that uncertainty?

Part of the answer to that might be defense-in-depth.

A second thing to keep in mind is that defense-in-depth should be commensurate with safety margins. The level of defense-in-depth that you ask for for the spent fuel, where there is so much margin, cannot be reasonably expected to be the same as you would ask for in a reactor situation where the margins are quite different, so we need to take that into account in thinking about defense-in-depth.

Finally, we need to recognize that there should be some compatibility between a decommissioning spent fuel pool and an operating reactor spent fuel pool, so you would not ask for defense-in-depth that would be out of whack with what you ask for in an operating reactor's spent fuel pool because the situation is not that much different.

These are the three important factors that we would take into account in asking questions regarding defense-in-depth. Now what kind of defense-in-depth would we be asking for? That is something that you would work, that we would work out as part of the rulemaking process or the exemption process. One of the things if you look at these three factors that you might ask yourself is with regard to emergency planning, if you were to exempt the licensees from offsite emergency planning based on the phenomenology of the spent fuel pool, you might ask if there might be some baseline level of offsite emergency planning that could be kept in place, that that might be a way of meeting these principles for defense-in-depth. Then we would have to have some discussion as to what that baseline would be. That of course is not a technical question for the Technical Working Group. It is a question that comes into the decision-making process.

So that is how we would view defense-in-depth. That is our preliminary take on defense-in-depth.

The final principle of risk-informed decision-making is that whatever you do based on risk-informed thinking you should be in a position to monitor the performance as it relates to risk analysis is that it tells you what is important. It tells you what to monitor and so our risk analysis and the NEI commitments are basically going to provide the basis for the risk analysis and those are the things we are going to have to monitor. The licensees are going to have to have to have programs and surveillances to monitor those important factors, and of course NRC's inspection program will be key, the inspection and oversight program will be key to monitoring performance in those areas.

So that in a nutshell is -- well, maybe not in a nutshell -- is what we think is a reasonable approach to risk-informed decision-making and a reasonable approach toward setting criteria for acceptability.

MS. HENDRICKS: I was curious about I guess the recommendations from the ACRS. I attended their meeting but maybe didn't have as much interaction with them as you did, but I guess I had two comments to make.

One was that part of the sense of using fuel uncovery seem to be based on an indication that, heck, you've got five days anyway -- what difference would five days or eight make? -- and I think that might have been correct in your old approach to human reliability assessment. I am not sure -- I don't know, but I am not sure it would still be an accurate underlying assumption if you do in fact do the HRA. I would suggest that you could look at that.

The other point that I wanted to make is I don't think the ACRS had the benefit of the explicit commitments that NEI has made for the industry and one of those commitments, as you recall, is the commitment to have a system in place to remotely connect for refilling the pool, so I don't know that -- if you take that commitment at some face value, I don't know that it is then correct t say that once you get close to fuel uncovery you are gone because of the radiation difficulty of getting close and replacing water.

I know the context of the discussion at that point again without the commitment was, you know, NRC had looked at the issue different in terms of could you approach, you know, with no in-place provisions with the fire hose, and I think you for good reason had some trepidation about saying yeah, let's just say that's feasible, so I would just maybe like to suggest that those conclusions be reconsidered in light of those two points.

MR. BARRETT: Yes, I think that those are two valid points and I think that they should be taken into account. Glenn, do you have --

MR. KELLY: Yes. Your exactly right -- I think it's that commitment about putting the offsite, not offsite but the outage building, a place where you can put water in is very important. What was raised by the ACRS was something that we had not considered was that there are certain -- as the fuel is being uncovered that there are certain ways that the fuel can in its heatup -- the fuel may be creating, I forget the name was -- it was nodules --

MS. HENDRICKS: Hydriding nodules.

MR. KELLY: Right, and he was concerned that these might cause problems at much lower temperatures and that you -- even the temperatures that we had postulated at 800 degrees centigrade for the initiation -- might be too high and there was just so much uncertainty associated with how the fuel would actually respond under those type of conditions that it was prudent to consider that any time you are in a situation where you uncover the fuel you really don't know how the fuel is going to respond. That I believe is what his major point was.

MR. CANAVAN: Ken Canavan, GPU Nuclear. I am concerned about the definition of LERF. One of the reasons that I am concerned is because it doesn't just limit itself to the zirc window.

Now it's when you uncover the fuel, and I think you statement about we don't really know what happens to the fuel is probably accurate, but on the other hand we are no longer limited to a zirc fire window because if we uncover the fuel 10 years down the road --

MR. BARRETT: I'm sorry, let me clarify it.

What the ACRS meant was during the zirc fire window, not after the zirc fire window, so they were just making the distinction between during the zirc fire window if you uncover the top of the fuel, take that as being LERF as opposed to taking into account the extra time to actually get down to where the fuel would begin to start the fire.

MR. CANAVAN: Just one additional concern on that -- well, that answers the question that it then limits it to the zirc fire window -- and we have one other concern, which is it does take away the driving force between figuring out -- I guess right now there is a driving force and if you don't make that simplifying assumption you need to figure out what happens to the fuel or you need to look at the heat transfer mechanisms to get an accurate temperature, an accurate heatup to 800 degrees Celsius, or you need to look at the real initiation temperatures of zirc, and you may end up shortening the window by looking.

The simplifying assumption takes away the driving force to look. If you say it is the top of active fuel, granted it makes the analysis easier, but it also starts to become a precedent against which you measure things and later on when a licensee went for let's say a change to risk-inform their particular configuration, which exceeded the LERF and wanted to do the additional work, we have a precedent set that it is the top of the fuel rather than what is really happening, and which is boiloff to the bottom and then heatup and then each realistic heat transfer mechanisms boil away the zirc fire.

So I guess I just want to make the point that if it is brought out as, hey, this is a simplifying assumption that does reduce the time that is available and doesn't address the phenomenon that could occur and could change those values and maybe that is appropriate.

MR. KELLY: I think the ACRS's point was that you can -- one certainly could choose to do a more sophisticated and detailed analysis in order to attempt to determine what temperatures and how quickly the fuel heats up -- but I think the ACRS's point was that the uncertainties are so high and we have not provided you any guidance on exactly how you, you know, what kind of calculation we would want you to do, and that you could -- the industry might end up spending a lot of time performing a calculation. Not to say that you can't do it or don't have the right to do it, but I would just expect that it would receive a lot of interest on our part and also by the ACRS, saying that they would probably have some interesting questions to ask us about how we came up with our numbers.

MR. HUFFMAN: Their point is that because those uncertainties go unmentioned you might not have all that much more time in reality, so your ability to calculate it is enough in question that the extra time probably couldn't be indicated with high confidence.

MR. BARRETT: Well, let me put this in perspective. After we re-quantify the human reliability analysis and the heavy load drop analysis, and after we reconsider the criticality scenarios, in all likelihood the driving scenario would be the seismic scenario and in that scenario it may not be all that important to distinguish between the top of fuel and the total uncovery because there you would be talking about a more catastrophic draining of the pool and you might be talking about minutes instead of days so it may not be, the distinction between the top of the fuel and total uncovery may not be so important in the final analysis.

MS. HENDRICKS: Is there an opportunity -- I remember that there's a lot of additional time to actually boil down all the water, which is -- the boiling process is providing cooling, and then there is also more time for the fuel to actually heat up when there is no water. Could you at least take it down to that point where there is no more water instead of fuel uncovery? Could you take it down to fuel exposure, if you will, and then obviously don't take credit for the time if there's uncertainty that it would actually heat up to whatever your temperature was.

MR. CHEOK: That was just what they suggested not doing --

MR. STAUDENMEIER: By the time the water gets down fairly low in the bundles the fuel could be heated up to a very high temperature if you are not generating that much steam anymore. The amount of steam you are generating is proportional to the heighth of the water -- when you get down to low levels you are not generating much steam at all so you have got very little steam to carry the heat away out -- so you are going to be getting some pretty high temperatures.

MS. HENDRICKS: I agree with you, but even that is somewhat predictable versus just -- and maybe still gives you significant margin instead of just taking --

MR. BARRETT: If it turns out to make a difference, they that would be something, that would be a level of sophistication we might want to go to, but I am not sure that the way things are turning out in the study that it is going to make any difference, and I don't think we want to go into a discussion of hydride nodules which I would say even at the ACRS meeting that that was regarded as something speculative. It was more of a question than a statement on the part of the ACRS as to whether or not this was a problem.

So if it turned out to be a crucial point in the analysis, yes, absolutely, we would try to do it, but my sense is that that is not going to be a crucial point in the analysis. It is not going to matter to anything.

MS. HENDRICKS: Yes, but just to reinforce Ken's point, it does end up being potentially a disincentive to do something that might be smart to do, which is to have the remote alignment capability because you do think -- you see what I'm saying? -- if too simplistic of an assumption can actually remove incentive to be conservative on the other side.

MR. BARRETT: Yes. I understand. Good point.

MR. STAUDENMEIER: And that stuff is being worked on --

MR. RICHARDS: I think one of the advantages of that simplifying assumption is to keep the process moving. It is a conservative assumption. I think if we want to start studying what happens when the water starts going down below the top of the fuel we could extend this effort significantly so -- I don't think you could have it both ways.

MR. CANAVAN: I guess the point would be to just highlight it.

MS. HENDRICKS: Yes, keep it on the table potentially.

MR. RICHARDS: You mean it would be highlighted that that is a conservative assumption and we didn't want to go the extra step and if somebody down the road wants to come in for a site-specific exemption and provide their own study on a site-specific basis they can always do that.

MS. HENDRICKS: What is next on our agenda?

MR. HUFFMAN: Okay. If your discussion is complete -- it seems like a good discussion. I had an opportunity for NEI to make any additional comments.

MR. NELSON: Could we take a five-minute break and then we will see if there is any follow-up? How's that?

[Recess.]

MR. HUFFMAN: We'll proceed on. As a result of your caucus, do you have anything you'd like to say?

MR. HENRIES: The only item I wanted to bring out is that I'm hoping I'm going to get something from Goutam and you all about the seismic screening checklist. And as soon as I get it, we'll try to work it over. I appreciate the feedback, and we'll get it back to you as soon as possible.

MR. HUFFMAN: Yes, that is actually one of the major action items that I see out of this, is that, yes, we need to coordinate some way to ge this thing resolved.

MR. HENRIES: The shear issue, I think is fairly clear. I think I understand exactly where they're coming from.

The Level II screening for in-plane, I'd want to talk to them about exactly where they're coming from. I have a guess, but --

MR. HUFFMAN: We'd have to, I guess, develop some kind of a quick action plan in terms of setting up a call and maybe having a meeting, and getting out some kind of draft in advance.

MR. HENRIES: Or even an e-mail. We could try.

MR. HUFFMAN: Within the constraints that we need to get our final report out in January.

MS. JACKSON: And to allow the other stakeholders to comment as well.

MR. HUFFMAN: Yes, we would distribute it to all the other stakeholders.

MS. HENDRICKS: I have a couple more questions. Hopefully I can be real brief.

But we had included in the Aaron Report, sort of a derivation from Price Anderson to get to severe accident, if you will, which might actually be more comparable than a LERF.

And when you go through that derivation, let's see, it seems like you end up with a lower number because the time period is shorter of the risk; that you have the zirc-fire, and the number of sites that would be in that state.

MR. KELLY: That's a frequency; it's not a probability, and a probability would take into account, duration.

MR. BARRETT: Could you just tell us a little more about that? I don't recall that, what you're talking about.

MS. HENDRICKS: It's on page -- that's not useful.

MR. HANNON: Is it in the verification -- derivation?

MS. HENDRICKS: The Price Anderson are accidents with probability in operating reactors greater than 1-E (-3), assume a hundred reactors, consider a ten-year period.

It implies that the frequency of severe accidents per reactor-year be 1-E (-6). Application of Price Anderson to spent fuel pools can then be inferred to have the same probability, although this may be conservative relative to consequences such as early fatalities.

But the probability of accident in decommissioning plants, you'd want it to be, for Price Anderson purposes, greater than to or equal to the 1-E (-3); you assume you have 10 spent fuel sites in each 10-year period over a 10-year timeframe.

And anyway, it implies an order of magnitude less in the severe accident consideration that was considered in Price Anderson. I don't know if that was the direct driver to severe accident risk.

MR. BARRETT: It's just the fact that there are fewer plants in that condition.

MR. CANAVAN: Of short duration in that condition. Price had ten plants --

MS. HENDRICKS: A hundred plants.

MR. CANAVAN: A hundred plants for ten years.

MS. HENDRICKS: Anyway --

MR. HUFFMAN: When the person whose our expert on Price Anderson looked at that, and felt that that was not the driving consideration for Price Anderson, and essentially stuck by the position of 93-127.

And the judgment is whether this is a reasonably credible accident core for -- as a nuclear catastrophe, which is what his basis for recommendation on whether or not Price Anderson applies.

The considerations that we've talked about today are going to be a little more difficult than Price Anderson. We already have a

SECY up there and we've already got a Commission decision on it, that it did -- that a zirconium fire accident is a credible event for Price Anderson.

Once that decision is made, then it drives what you do. And Price Anderson is either all or nothing.

The Congressional legislation doesn't allow you to split off the secondary indemnification pool from the primary. You have to take it all.

And so there may be some more complicated actions under Price Anderson in terms of recommendations and legislative recommendations, ultimately.

MS. HENDRICKS: I thought there was a discussion at the Commission briefing, and I think it was in March, where they actually showed some chagrin of having approved that SECY, based on the fact that it wasn't a risk-informed, but it was a deterministic basis.

MR. HUFFMAN: We may reissue it.

MS. HENDRICKS: Relooking at it?

MR. HUFFMAN: Relook at it. Right now, that is the record decision, so there may be a policy issue that has to be taken in how this accident is classified.

MS. HENDRICKS: Okay.

The other point, I guess, was some concern I had about using the delta in consequence, instead of a delta in frequency. I guess I'm wondering why you would need to do that, and if so, gosh, the bases would seem to be so problematic.

MR. BARRETT: I think the point is that generally we're talking about license amendments in which the -- what you're affecting is the core damage frequency, and, therefore, the large early release frequency.

And you're having no effect on consequences. That's probably 99.9 percent of the decisions we make in a risk-informed environment.

Of course, therefore, those are the right criteria, delta CDF and delta LERF.

If you're making a decision that would have no impact on the probability or frequency, but would have an effect on the consequences, then, you know, it seems reasonable that you would want to -- you know, the higher level principle is the impact on risk. And risk, as we define it, is frequency times consequences.

And if the only thing that changes is consequence, then we should ask the question, well, how big is the change in consequence, and in some way can we make an equivalency in that change in consequence to the numerical criteria by 1.174?

That's where we're at right now. I don't know how else we would handle it.

MS. HENDRICKS: Now, I'm not sure exactly, but I guess I'd just like to make an observation that's really far outside of the Commission's PRA policy on, you know, where it does use frequency.

I think that stepping into consequences is a bigger step that just we need the surrogate. I think it has a lot of implications.

MR. BARRETT: It's not outside the policy.

MR. CHEOK: With the safety goal policy statement, and that does take risks and consequences of the various frequency events, and propagate out to those answers. And the option of using those approaches is, you know, within the guidelines, so it's not foreign.

It's just that the easier approach and an adequate approach has been frequencies.

MR. BARRETT: And the PRA policy statement says that the Agency would use risk to the extent applicable in all regulatory activities. And so you may be right; it may be difficult to come up with risk criteria, and I hope it's not.

But I don't think we can ignore it.

MS. HENDRICKS: I just think it gets you into a very speculative, very potentially a lot of site-specific factors, a lot of just really maybe get you into a lot of various --

MR. KELLY: Does anybody want to propose a different surrogate that's applicable? I mean, originally it was 10(-6) and there is a good chance that seismic -- at 10(-6), and I don't see much chance of that being reduced much below 10(-6), absent plant-specific analysis.

MR. HUFFMAN: We can't hear you.

MR. KELLY: I'm saying that I don't -- NEI previous proposed 10(-6) as a criterion for the frequency of zirconium fire, and we -- I think it would be very difficult to demonstrate that you could get below 10(-6), given the seismic numbers that we're coming up with, absent plant-specific analyses.

MR. BAGCHI: On seismic, and we say that there is a potential to consider what kind of a ground motion is credible. And that could make a change in the frequency.

So, not so fast, that's all I can report.

MR. BARRETT: But the point is that, you know, we need technical results, and we need criteria. And if we're going to define criteria, the definition of the criteria in Reg Guide 1.174 was a time-consuming activity with a lot of involvement of everyone inside the Commission and outside the Commission.

And to start somehow de novo and say, well, our new criterion is something totally unrelated, it seems that it would be a lot more time-consuming and painful than to say we think we can define something equivalent in risk-based, different but equivalent. That might be something that would attract -- be more likely to attract a consensus than something that would just be totally new.

MS. HENDRICKS: Yes, and I certainly appreciate the difficulty in where you're trying to go, but maybe a final observation: It's very speculative.

I mean, we said earlier that we don't intend to necessarily have highly-refined models to even get to the fire, let alone beyond.

So if you were going to look at a delta in risk which would be the consequence, how would you begin to do that, given that you've not even modeled beyond simple -- a very simplistic point of fuel uncovery.

Wouldn't it get to be real, real speculative?

MR. BARRETT: No, I think speculative is too strong a term. We actually asked the Office of Research to do some preliminary assessments for us of what would be the consequences of this type of an accident?

And, you know, PRA analysis in the Level II and Level III area can be very difficult. It can be -- you know, there is a lot of phenomenology involved.

But a lot of that phenomenology relates to determining whether or not a core melt accident can get outside of containment. A lot of that complication is really not relevant here because this particular accident will be happening outside of containment.

So you would be going from a release from the fuel, right into a Level III analysis, which would be transport offsite, the effectiveness of offsite protective actions, and the dose consequence calculations.

The Office of Research did some calculations like that for us, so they're not easy calculations, but they're far from speculative.

You know, I think that it's a promising area to look at.

MS. HENDRICKS: I guess I'd still have some concerns because you're making kind of a grand leap of faith. You know, you've got some precision, and then you've got a hole where there is a lot of uncertainty.

And then you're sort of making a grand leap of faith back to some pretty precise calculations. And what you're forgetting in the interim is how does this -- what happens after uncovery.

I mean, the assumptions for the heat up, you know, we tend to want to, you know, keep coming up with mechanisms that lower the temperature, but then you've still got this adiabatic heatup assumption. That is a big, big conservatism.

MS. JACKSON: That's not being used.

MS. HENDRICKS: Well, you don't have to use it if you just to fuel uncovery. But certainly in picking your temperature, you haven't given any credit for release in that period; have you?

MS. JACKSON: The adiabatic calculation doesn't have anything to do with the temperature that we're setting. That's a different type of analysis.

MS. HENDRICKS: But to get the temperature, you've got to assume that you've got adiabatic conditions.

MS. JACKSON: No, no, different calculations.

MR. KELLY: The timing may be potentially what we've told you is non-conservative. And the reason why I say that is when we have given you the drain-down time for the water to go away, we looked at that strictly based on boiling off the water and assuming that the fuel was not heating up while it was boiling over.

And then we did our heatup calculation as if the water instantaneously went away and then we heated up from there. What is really happening is that we are boiling down, and you're getting less steam, and the fuel is heating up, so you're starting out at a much higher temperature than what we assumed.

So, if we did a detailed calculation taking into account the boil-down, the potential heatup of the fuel during boil-down, and then the heatup time subsequent to the boil-down, we may well see much shorter times than if you just simply take the boil-down time in our original heatup calculation.

I don't know if that makes sense.

MS. HENDRICKS: Well, it did, and I agree that you may have had some conservatism in there, but if I recall --

MR. KELLY: It's optimism, not conservatism.

MS. HENDRICKS: You're right, I misspoke, it's optimism.

But you still, in my recollection, in these same policies, there was no credit for convective heat removal during this scenario.

MR. STAUDENMEIER: That's not true at all. I mean, adiabatic heatup calculation was used for one license exemption to get a quick estimate of how much time you had for the fuel to get up to a given temperature. But that hasn't been used at all for the Technical Working Group estimates.

MS. HENDRICKS: I guess, you know, maybe when the study is released, we'll have a better opportunity, but I guess I misunderstood that.

MR. BARRETT: Let me not pursue than any further, but we need some sort of criterion. I think that the industry recognizes that. You've made a stab at a criterion.

The Commission has asked us to find some sort of objective, risk-informed environment, and I don't know what other criterion we can come up with that's apropos to the type of relief we're talking about.

I think that's basically where we are. You're going to make a decision. That decision is going to have an impact on risk, and we need to analyze that impact as it is, not using some criteria that's irrelevant or that's not impacted.

So what's where we came up with this approach. If there is an impact, for instance, on risk associated with relaxations in emergency preparedness, if there is, and to the extent that there is, that's an impact on consequences, not probability.

So that's the thinking, and, I mean, it's pretty simple.

MS. HENDRICKS: I wish I did have a great answer for you today, but I don't. But we'll commit to give you our thoughts, and if we come up with something brilliant --

MR. BARRETT: I know this is the first time you've seen this, and it's the first time a lot of people in this room have seen it.

So it's a start.

MS. HENDRICKS: Just to reemphasize the point that Bill made, we're certainly very appreciative of this opportunity, and we're not criticizing.

MR. STAUDENMEIER: One point on the adiabatic heatup, too, the only reason that was ever used is the licensee stopped answering questions about their heatup calculations. We could have accepted their heatup calculation if they would have continued to review that.

We found a lot of problems when we reviewed the heatup calculation. They stopped answering questions. We came up with a criteria to grant the exemption, and that was used for a timing estimate for what time you would be good enough, in lieu of getting rid of emergency planning.

MR. HUFFMAN: Anything else?

(No response.)

MR. HUFFMAN: This then leads into a public comment period.

MR. ATHERTON: Am I the public?

MR. HUFFMAN: You're the only one left.

MR. ATHERTON: I've already spoken, but I have a number of other concerns. I'd like to hear from other members of the public before I go on, if they have any comments.

MR. HUFFMAN: I believe they said they did not. Could you step up to the mike?

MR. ATHERTON: Is this being recorded?

MR. HUFFMAN: Yes.

MR. ATHERTON: Mr. Barrett, you were talking about defense-in-depth. That's at the top of my list here. What did you mean about defense-in-depth as it applies to the spent fuel pool?

MR. BARRETT: Well, I think we you need to start with where we are today on operating reactors. In operating reactors, I think we've made a qualitative judgment that the level of defense-in-depth as it applies to the pools is sufficient.

And that relates to the systems that are available, the operational staff that's available and their procedures, the structure of the pool, the buildings that surround the pool, and the emergency planning which can have an impact on the consequences of an accident.

And that level of defense-in-depth is significantly different from the level that you have for the reactor. The reason is that the margins are different.

I use the word, margin, but you could characterize it differently. The nature of the hazard is significantly different.

MR. ATHERTON: I was looking at the reactor side of the defense-in-depth. I believe Ms. Jackson also phrased it as the design of the system at safety grade standard, generally speaking, everything within the containment.

MR. BARRETT: Right.

MR. ATHERTON: For all practical purposes, you have the ability automatically to cool the core in the even there was a transient or accident or anything that required emergency core cooling.

You had a reinforced concrete shell around the containment.

MR. BARRETT: Right.

MR. ATHERTON: All of these did not require any human involvement in order to be there. They were either passive or they were automatically actuated.

So that type of defense-in-depth is different from what you're describing currently exists in the spent fuel pool.

MR. BARRETT: Right.

MR. ATHERTON: I think you concluded that if there is a catastrophic event -- just a few minutes ago -- I'm going to paraphrase what you said, but if there is a catastrophic event at the spent fuel pool, the public essentially is going to be affected by that event and the release from the spent fuel pool.

MR. KELLY: The public will be affected similar to the way that the public would be affected if there was a loss of coolant accident in conjunction with a breach of containment for a large early release.

So, there is a possibility that even with the reactor that you can have a large early release. It's a low probability event, but that is a possibility, and something we'd look at.

And there is also possibility here that you could have a low probability event that could have a large release also. It wouldn't be an early release; it would be a late release and would be a different kind of release, but it would still be a significant release.

MR. ATHERTON: Have yo had an opportunity to compare the probabilities of the breach of containment and the types of accident scenarios that would be involved in a breach of containment?

MR. KELLY: Yes.

MR. ATHERTON: With the scenario that occurs?

MR. BARRETT: Yes, this is the whole discussion of what we've talked here about, the criteria in Reg Guide 1.174. What those criteria relate to are core damage frequency, which is the probability or the frequency with which you would have an accident and this whole sequence of failures that would lead to damage to the core, inside of containment.

And then you have large early release frequency, and that's a lower probability, a lower frequency, generally, because you would have the conditional probability that you would also fail containment or bypass containment or breach containment in some way.

So those -- we have probabilistic risk assessments for all the plants that have calculated, at least the core damage frequency, and in many cases, the large early frequency.

We have criteria that we've put in place for use in many regulatory environments, Reg Guide 1.174 criteria. The calculations that we're doing for the Technical Working Group are intended to put the accidents and the accident consequences and the accident frequencies for spent fuel pools on the same plane so that they can be looked at in the same way, using similar criteria.

So that we can say that the level of public protection, that the potential risk to the public is commensurate or perhaps even lower.

Okay, so that's really the whole thrust of this thing when we talk about the risk-informed approach to this thing. We're looking at --

MR. ATHERTON: Well, we've looked at -- I've addressed the subject of the use of probabilities from actual accidents that have occurred and the computation of the probability, a probability number from an actual accident. I raised the TMI-2 accident, and I've done a considerable amount of reading about that.

And in none of those documents, has the accident at TIM-2 been termed a loss-of-coolant accident outside containment, which is basically what it was. It bypassed containment, you might say.

The auxiliary building filled with reactor coolant water.

MR. BARRETT: Let me say that when we talk about a loss-of-coolant accident outside containment or what we sometimes refer to an interfacing system loca type of accident, what we're talking about there is -- you know, there's always a question of degree.

What we're talking about there is a case in which a substantial fraction of the fission products or the radioactive material that's released inside containment or released from the core, also finds its way outside of containment.

In the Three Mile Island accident, as in any accident that you might postulate, there is going to be some amount of material that finds its way out of containment. There is going to be some small leakage through penetrations or through valves.

There is going to be -- in the case of Three Mile Island, I think what you're referring to is the fact that they were pumping fluid outside from the sumps and back into the reactor using pumps that were outside of containment.

And that necessitated bringing water outside of containment and recirculating it back in. Is that what you were referring to?

MR. ATHERTON: The information that I read -- this is difficult to find, by the way, and I had to piece it together. But what I pieced together from TMI-2 that doesn't read in any report that I've seen like this, is essentially that when the pressure-operated relief valve opened up, the water was supposed to go into a tank located inside containment.

The tank inside containment has a connection to another tank outside containment. I think it was in the auxiliary building.

And that there was a bypass valve or connecting valve that was left open inadvertently.

And when the containment tank filled up, the water went into the other tank located outside containment, and it filled up and overflowed, and you had several inches of water inside the auxiliary building.

MR. KELLY: What it was, there was a sump in containment that when the -- my recollection of what happened at Three Mile Island is that when the PORV opened and the relief tank opened up also, as it's designed to do, that the water overflowed down into a sump.

That sump was aligned and was pumped outside of the building. And then it went from that tank to another tank, and that tank that it, in turn, went to, overflowed. So that cause some spillage of a small amount of water relative to the water that was in the reactor that did get pumped outside of the building.

Most of the water did not go into the sump. What did go into the sump did get, for awhile, got pumped outside of the building till it got closed.

So, normally when we're talking about an interfacing system loca, we're talking about a non-isolable break where, for example, in the RHR system, where you have a low-pressure system outside of containment, such that if you were able to break through some check valves and other valves, and you've got a break in the low pressure system, that you wouldn't be able to isolate it, and the water would just continue to come out of the reactor through this break, outside of containment, such that you wouldn't be able to run it through the sumps and recirculate it back into the reactor. That wasn't the case here at Three Mile Island.

That isolated the break and that closed the PORV block valves, and they just went back to pumping the water again. So it was a very difference type of accident.

MR. RICHARDS: Peter, how does this relate to spent fuel pool risk?

MR. ATHERTON: Regardless of the mechanism, what happened, you did get reactor coolant water outside containment flooding the auxiliary building. I would term that as a loss of coolant through the PORV, which ultimately ended up outside containment, however you wish to term the mechanism by which it happened.

What I was trying to get at was I had asked Mr. Barrett at one time, the probability that the sequence of events that occurred at TMI-2, and the manner in which they occurred, what was the actual probability that this would have happened. And when we come up with a number from an actual accident like this, it gives us some kind of insight or basis into one of two things. If we get a very low probability, one in a billion perhaps, are we talking about, you know, a low real probability event actually transpiring and actually happening, or is our -- are the mathematics that are used to compute this probability, are they somewhat defective? And the probability might have been greater because --

MR. BARRETT: Let me answer your question, let me answer what I think is your real question. And I think your real question is, do we have a realistic database to support the calculations we do in PRAs? I think, that is the question I think I am hearing.

MR. ATHERTON: That is a good way to summarize it.

MR. BARRETT: Yeah. And let me answer it to the best of my ability. I think when you look at PRAs, you start with some very fundamental data. What is the probability that this pump will fail to start, or this valve with fail to open on demand? Or this diesel will fail or start, or that this human will make this make, or fail to follow this procedure? These are the basic makeup of a PRA, these little probabilities. And a lot of money, and time, and effort, and experiments have been expended to try to understand what those probabilities are, real live data from real live nuclear power plants and other facilities, real tests, experiments, analysis, some of it theoretical, especially in the human area. So there is really a very good database for that.

Now, let me -- just let me finish. Now, you would say, well, gee, that is nice, but then there is all this mathematics that you do if you go through the sequence analysis, and it is a long way from that basic data to where you get to say, well, I think the probability of a core damage accident is 10 to the minus 5 for a reactor year. Is there anything in between those two extremes that we could say, yeah, we have a benchmark for some of that? And the answer is, yes, there is.

We have an active program in the NRC to gather operational experience, and that operational experience ranges from some relatively insignificant things that happen every day at nuclear power plants, all the way up to the most significant things that happen every year at all the nuclear power plants, and we call those things precursors. And we examine all of that information, and in the case of the precursors, we actually calculate how close to core damage we got with those precursors. And over the years, and when I say over the years, I mean we have those precursors going back to 1971 or '69, I forget.

MR. KELLY: Sixty-nine.

MR. BARRETT: No, I think we go beyond '69, I think we actually go into the '70s, into the early '70s. And we not only look at -- ask ourselves, is the frequency of these precursors consistent with what we think is the frequency of an actual core damage event? But, periodically, we look at those precursors and say, are the type of things that are showing up in the precursors similar to the type of accident sequences that we predict in PRAs are important? And within reasonable bounds, I think the answers are yes to both of those questions.

MR. CHEOK: It is also probably worth bringing up that for all the complexities of trying to analyze human performance over days rather than hours, the basic failures in models of things that can go wrong in the spent fuel pool are much simpler than all the complexities that go into a risk assessment of an entire reactor. So we are looking at sort of a small subset, certainly some challenges in doing the analysis, but it is not nearly as huge a problem.

MR. ATHERTON: Let me ask a question going to a specific item, for instance. The failure rate data, which I guess is part of the basis of what you are doing, in order to get an accurate failure rate data, you have to have an adequate control over the equipment. If the equipment meets a certain safety standard, then you have a basis, it would appear to me, to get a determinative failure rate for that equipment. If there is no specific standard to which this equipment is required to be designed and operated by, how are you able -- and you are using this other non-safety-related equipment as standard data, do you segregate, do you take into account the differences in the quality of construction of this equipment in determining your probability numbers?

MR. BARRETT: Well, the answer is that -- I am going to ask Glenn, in a minute, to give you a more detailed answer of the specifics. But it is not just the quality of the equipment that helps you determine its reliability, but it is also what surveillances, how is it maintained. How frequently do you go in and actually try to start it and what kind of results do you get when you do that? So it is not just whether the pump, for instance, was constructed in a way that was consistent with a given standard, we couldn't count on that exclusively, what we count on in addition is the operational experience with pumps of that type in the field, and the operational experience of that pump as it is being surveilled, for instance.

But let me ask Glenn to talk about the specific numbers that were used in this analysis, which I guess is your question.

MR. KELLY: I think the key is that we have actually found that, from the standpoint of reliability, that most of the time that the equipment that has an N stamp, and equipment that doesn't have an N stamp, operates at about the same reliability. You wouldn't be able to look at one or the other and determine which one, from a reliability standpoint was really doing better.

What we have found is that, because we take data from equipment, for example, on the secondary side of a pressurized water reactor which is not normally safety grade equipment, and we still collect that data as far as the reliability of that equipment, and that is factored in, the feedwater pumps, all these types of things, not safety grade equipment, but their reliability tells information about -- a lot about, again, these type of pumps and other -- there are pumps all over the plants that are like that.

We took generic type numbers for the pumps here. They are relatively small pumps, the valves are relatively small, relatively simple systems. The numbers that we came out with are not really -- they are not driven by those numbers, they are driven by the numbers -- the numbers that we calculate where the problems are, are driven by human errors, or they are driven by earthquakes, or they are driven by heavy load drops. They are not driven by equipment failures.

Plus, where we have determined that equipment is important, what Rich was talking about earlier is that what we would propose is that, as part of the five parts of Reg. Guide 1.174, one of the things it talks about is having a program that monitors whether the equipment, personnel, et cetera, that we are banking on working, whether it is really working that way.

And so one of the things that we would probably want to do is talk to the licensees about what they plan on doing, whether they put some of this in their maintenance rule, part of their program, or what it is that they are doing to help make sure that this equipment stays as reliable as they expect it to be.

We don't really think that the equipment reliability is going to turn out to be the dominant concern here. Does that help answer your question?

MR. ATHERTON: Well, it helps avoid answering my question. But you are saying there are other factors beyond which we have human control that are going to manifest themselves as the driving force.

MR. KELLY: No, I didn't say they were beyond human control, I just said that those are the things that are the dominant drivers in the risk assessment. These are the things that contribute the most towards making the risk numbers as high as they are. And to the extent that we can take a look at these, whether it is through the checklist that we were talking about for seismic or whatever, we are going to address these particular issues.

MR. HUFFMAN: I would like to make a point that we are already past the end time for this meeting, and without tieing up most of the rest of us here that may not be directly involved in this conversation, you might want to consider some sidebar specific discussions after this meeting. But unless there is something, we will maybe entertain one more directly relevant question on the spent fuel pool risk, I would like to get on and conclude this.

MR. ATHERTON: I will escalate from the details of failure rates of specific equipment to a broader question. I am not -- it does not appear that you are considering, for instance, the worst case scenario that you can expect to encounter as a driving force for determining what the probabilities of this, that or the other are going to be. Is that an accurate statement?

MR. BARRETT: What is the basis for that? Do you have a worst case scenario in mind that we are not --

MR. ATHERTON: Let's start with the broadest. Mr. Kelly, you had indicated at one of the previous meetings that the worst case scenario of a spent fuel pool accident, with the release of all the available radionuclides, and I don't know how many cores' worth of fuel we have in the spent fuel pool, but the consequences to the public would be similar to that of a breached containment in a reactor accident, worst case reactor accident. You are basically, essentially saying that there can be some very ill effects to the public as a result of a significant release of radioactive material from the spent fuel pool.

MR. BARRETT: That is correct.

MR. ATHERTON: Taking that as the broadest question. So, we have a genuine concern with something significant happening in the spent fuel pool.

MR. BARRETT: That is right.

MR. ATHERTON: And we don't have the equivalent of reactor-defined defense-in-depth concepts with the spent fuel pool. We have different ways of looking at it, as you indicated. And so, the bottom line is whatever does happen in the spent fuel pool is going to make its way to the public sector, and we are going to have some significant consequences, depending upon the size of the accident, to the spent fuel pool.

How does that drive your -- realizing that if anything at all happens of any consequence in the spent fuel pool, the public is going to be affected by it, comparing that with a reactor, you have various levels of defense-in-depth that you can resort to to try to contain the accident, you don't have a similar basis for containing a spent fuel pool accident, how does that drive your decision as to whether or not certain safety bases should be included in the ultimate --

MR. BARRETT: I think that has been the subject of this meeting, really. You know, what we have asked ourselves is, to go back to the basic safety principles of risk-informed regulation and one of those is to look at the probabilities and consequences, that is one, of the accidents. Okay. And we have done that, and the probabilities and consequences here, at least based on where the numbers seem to coming out, are lower than what you would expect from the reactor for similar, for accidents of similar magnitude, okay.

So, in other words, the level of protection from a probabilistic perspective is greater for the spent fuel pool than it is for the reactor. Now, but we don't stop there. We ask ourselves, do we have -- how robust is that finding? And when you ask yourself how robust is that finding, you wonder, are you putting all your eggs in one basket, for instance? Do you have defense-in-depth? Is that defense-in-depth appropriate to the situation that you are facing?

Now, you have characterized the defense-in-depth that is available for the reactor. What do we mean when we say defense-in-depth? We mean prevention, protection and mitigation. That is to say measures that are in place to prevent something from going wrong in the first place, measures that are in place to respond in preventing that accident from getting out of control, and then if the accident were to get out of control, measures that are in place to mitigate its consequences.

Now, in the reactor case you have all three, and in the spent fuel pool case, you have all three. But in each case, what you have in place should be commensurate with the challenge.

For instance, let's talk about the mitigation of an accident should it start. In the case of a reactor accident, if you get a reactor accident starting, you are starting from high pressures, high temperatures, high flows. You are talking about decay heat that is as much as 7 percent of the total power of the reactor. You are talking about events that can unfold rapidly in some scenarios. You need to have that protection. It has to be automatic, it has to be rapid. It has to be redundant. It has to be diverse. It has to have independent sources of power. It has to be backed up by emergency operating procedures that -- you know, licensed operators. You know, that is commensurate with the hazard you are facing.

Now contrast that with the type of accident you are facing in the spent fuel pool where you have a cool pool at ambient pressure and temperatures, you have decay heat that is far less than 7 percent, probably far less than 1 percent of the power. You have an accident that might unfurl over hours or days, as opposed to seconds and minutes and hours. And so the level of protection doesn't have to -- you know, you say what level of protection do I need for that? It is different, but it is still there. Okay.

MR. ATHERTON: I realize you are picturing two different types of systems. One is essentially a quiescent condition, while one is an operating state and under a considerable amount of stress. However, we also have two different situations. One is designed to cope with that stress, and one of the concerns that, to me, is becoming more and more really a concern is the possibility of a terrorist act targeting the spent fuel pool simply because if there is an operating reactor alongside of it, the operating reactor is so well protected that it is going to take a considerable effort to breach its levels of defense, whereas, to do that with a spent fuel pool will take much less of an effort because it does not have the level of defense-in-depth protection that you have at an operating reactor.

And your scenario obviously does not take into account this difference, the probabilistic assessments that you are using do not take into account the fact that the spent fuel pool is exposed to the atmosphere only protected by a certain layer -- level of water, and that is all you have.

MR. RICHARDS: Peter, I think we are going to have to truncate the discussion. I mean we are up to 4:00, you know. If you would like to stick around, staff will stick around to continue the dialogue, if you would like. Bill.

MR. HUFFMAN: Yeah. I would like to summarize the action items as I see it.

Number 1, most importantly is get something going in terms of beefing up the seismic checklist, setting a -- calling a meeting, and getting a draft of that in the next week or two. So that is item Number 1.

Another thing I thought I heard is that -- kind of an internal action item for Rich is he is going to factor in HRA improvements into the seismic sequences. And I think he agreed that that was a valid point of consideration.

And, finally, I think, Lynnette, you said you would look at giving us your thoughts on the risk criteria. It should be greatly appreciated if you have got some ideas on that.

And, of course, there were a lot of good, qualitative discussions that I think will benefit the staff in terms of the ultimate report, the write-ups anyway.

I would like to thank the staff for their presentations, excellent, and participation. And if there is no other questions or comments, I adjourn.

[Whereupon, at 3:58 p.m., the meeting was concluded.]